Bell Work
23-Sept-14

Using your knowledge of matter, how would YOU describe an atom?
Give at least three (3) specific points for your description. In addition you may draw what you think an atom looks like.

EQ: How could a conception of interactions between atoms help further your understanding of our universe?

OBJECTIVES:

- Observe presences of a negatively charges subatomic particle
- Size up an atom

A thought on the atom & our universe by Neil deGrasse Tyson

The most astounding fact

http://youtu.be/9D05ej8u-gU

Recall…

What is the scientific method?

List the part and them describe.

The Scientific Method

Ask a question

Research the Question

Form a hypothesis

Test hypothesis through an experiment

Analyze data and form a conclusion

Communicate your results

Dalton's Atomic Theory (experiment based!)

1) Elements are composed of tiny indivisible particles called atoms
2) Atoms of the same element are identical. Atoms of any one element are different from those of any other element.

John Dalton
(1766 – 1844)

Dalton's Atomic Theory (experiment based!)

3) **Atoms of different elements combine in simple whole-number ratios to form chemical compounds**
4) **In chemical rxns, atoms are combined, separated, or rearranged – but never changed into atoms of another element.**

John Dalton (1766 – 1844)

Structure of the Nuclear Atom

One change to Dalton's atomic theory is that atoms are divisible into subatomic particles:

Electrons (e^-),

protons (p^+),

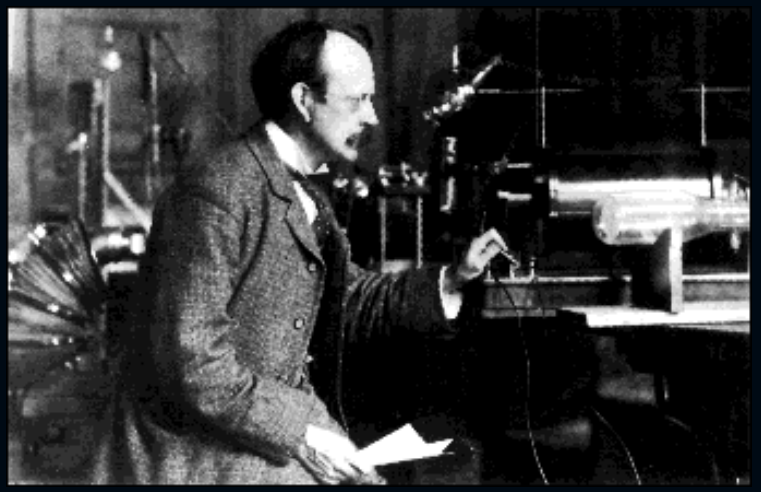
neutrons(n^0)

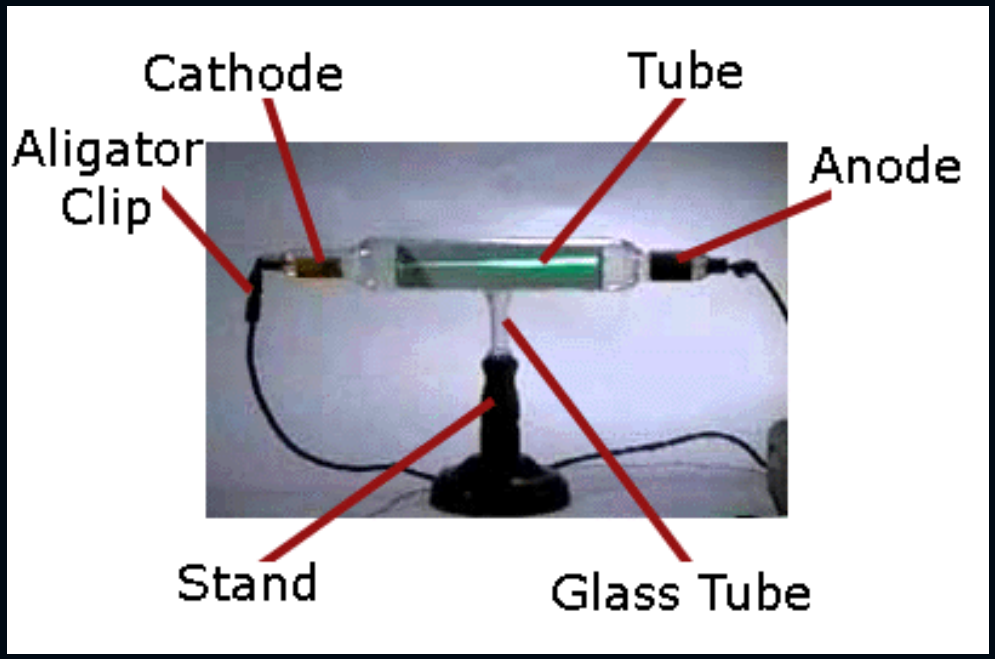
are examples of these fundamental particles

There are many other types of particles, but we will study these three (3)

Discovery of the Electron (e^-)

In 1897, J.J. Thomson used a *cathode ray tube* to deduce the presence of a negatively charged particle: the electron (e^-)





Modern Cathode Ray Tubes

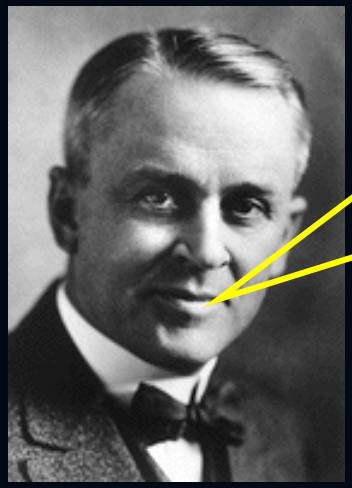
Television

Computer Monitor

Cathode ray tubes pass electricity through a gas that is contained at a very low pressure.

Mass of the Electron

The oil drop apparatus



Mass of the electron is 9.11×10^{-28} g

1916 – Robert Millikan determines the mass of the electron: 1/1840 the mass of a hydrogen atom; has one unit of negative charge

http://youtu.be/XMfYHag7Liw

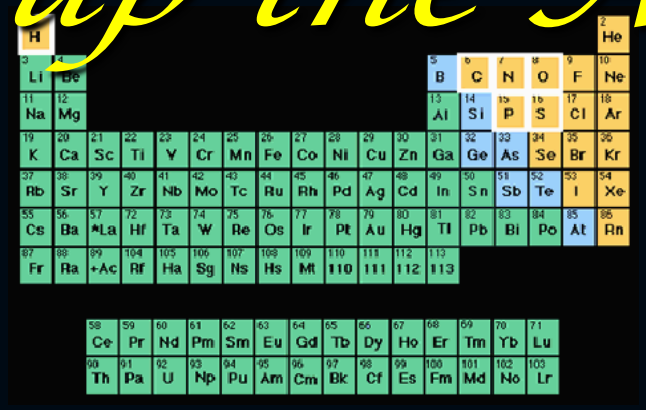
Conclusions from the Study of the Electron:

a) **Cathode rays have identical properties regardless of the gas (element) used . All elements must contain identically charged e^-.**

b) **Atoms are neutral, so there must be positive particles in the atom to balance the negative charge of the e^-**

$(p^+) + (e^-) = Charge$

Sizing up the Atom

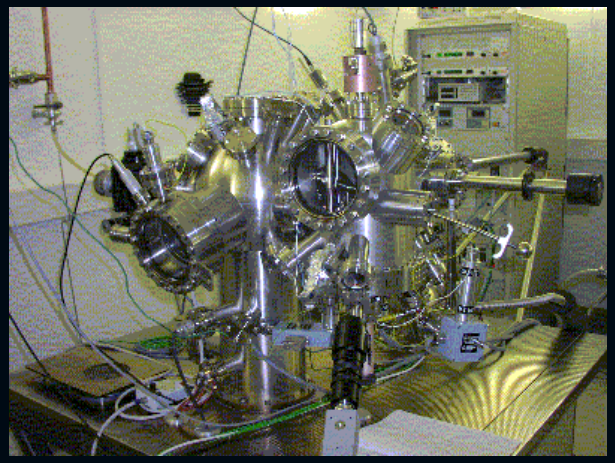


Elements are able to be subdivided into smaller and smaller particles – these are the *atoms*, and they still have properties of that element

Sizing up the Atom

If you could line up 100 000 000 Cu atoms in a single file, they would be approximately *1cm long*

Despite their small size, individual atoms are observable with instruments such as *scanning tunneling (electron) microscopes (SEM)*

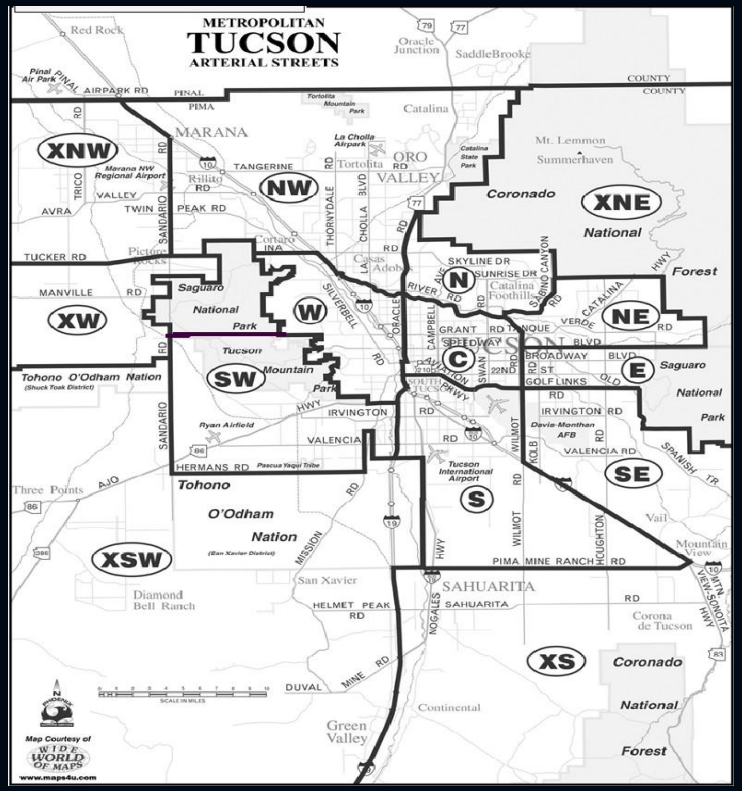


Conclusions from the Study of the Electron:

c) Electrons have so little mass that atoms must contain other particles that account for most of the mass

Mapping atomic structure

You will use a string and a meter stick to determine the diameter of one of four (4) different balls.



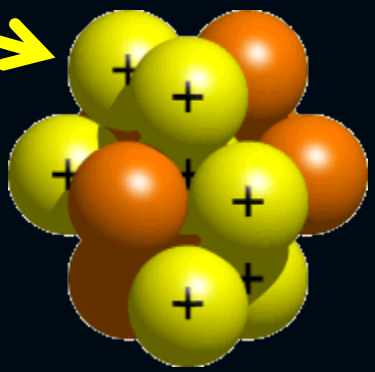
1.61 km = 1.00 mile

Then you will relate the diameter to the size of a nucleus and draw it on the map of Tucson.

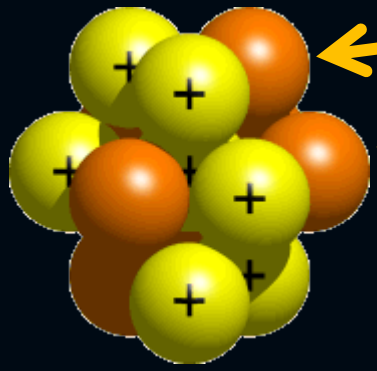
Conclusions from the Study of the Electron:

Eugen Goldstein in 1886 observed what is now called the "proton"(p^+). Particles with a positive charge, and a relative mass of 1 (or 1840 times that of an e^-).

Protons



Conclusions from the Study of the Electron:



1932 – James Chadwick confirmed the existence of the "neutron" – a particle with no charge, but a mass nearly equal to a proton

Turn In
23-Sept-2014

Writing Prompt: 3D soil scanners

Bell Work
24-sept-2014

What experiment was used to determine the presence of the electron?

Explain the apparatus used?

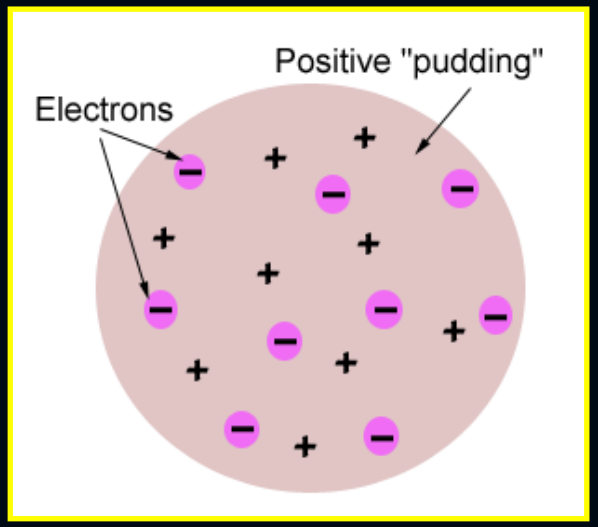
OBJECTIVES:

- Explain where the mass of an atom and the bulk of the volume are located in an atom

Subatomic Particles

Particle	Charge	Mass (g)	Location
Electron (e^-)	-1	9.11×10^{-28}	Electron cloud
Proton (p^+)	+1	1.67×10^{-24}	Nucleus
Neutron (n^o)	0	1.67×10^{-24}	Nucleus

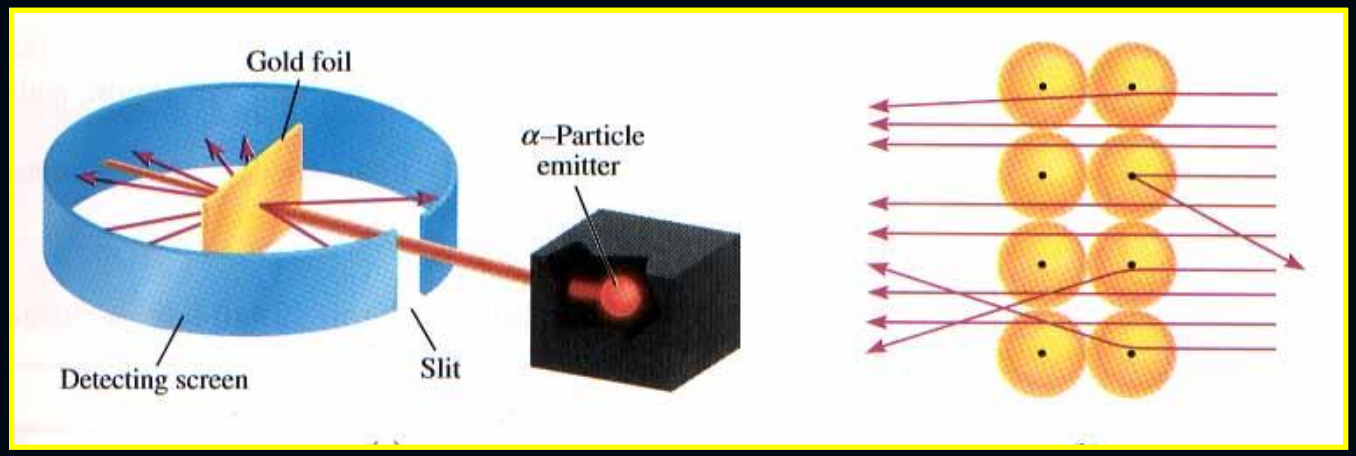
Thomson's Atomic Model



J. J. Thomson

Thomson believed that the e^- were like plums embedded in a positively charged "pudding," thus it was called the "plum pudding" model.

Ernest Rutherford's Gold Foil Experiment - 1911



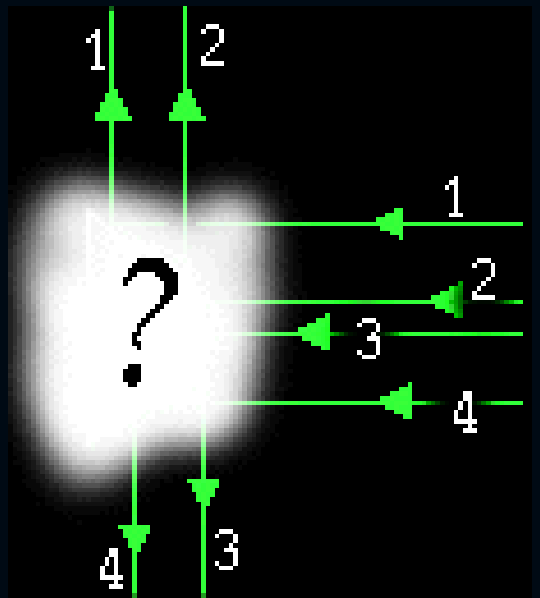
- **Alpha particles are He nuclei - The alpha particles were fired at a thin sheet of gold foil**
- **Particles that hit on the detecting screen (film) are recorded**

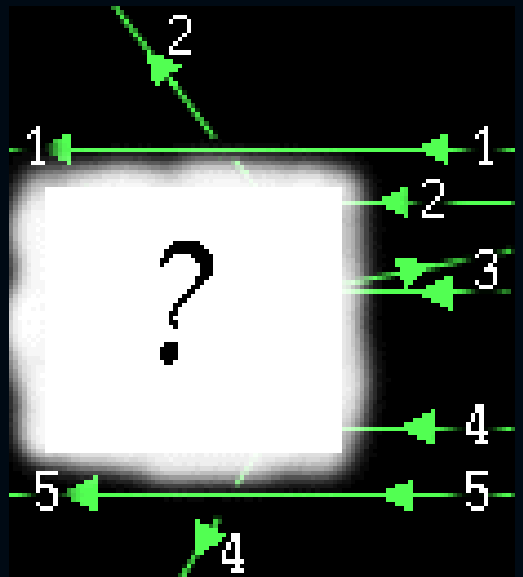
http://micro.magnet.fsu.edu/electromag/java/rutherford/

Rutherford's problem:

In the following pictures, there is a target hidden by a cloud. To figure out the shape of the target, we shot some beams into the cloud and recorded where the beams came out. Can you figure out the shape of the target?

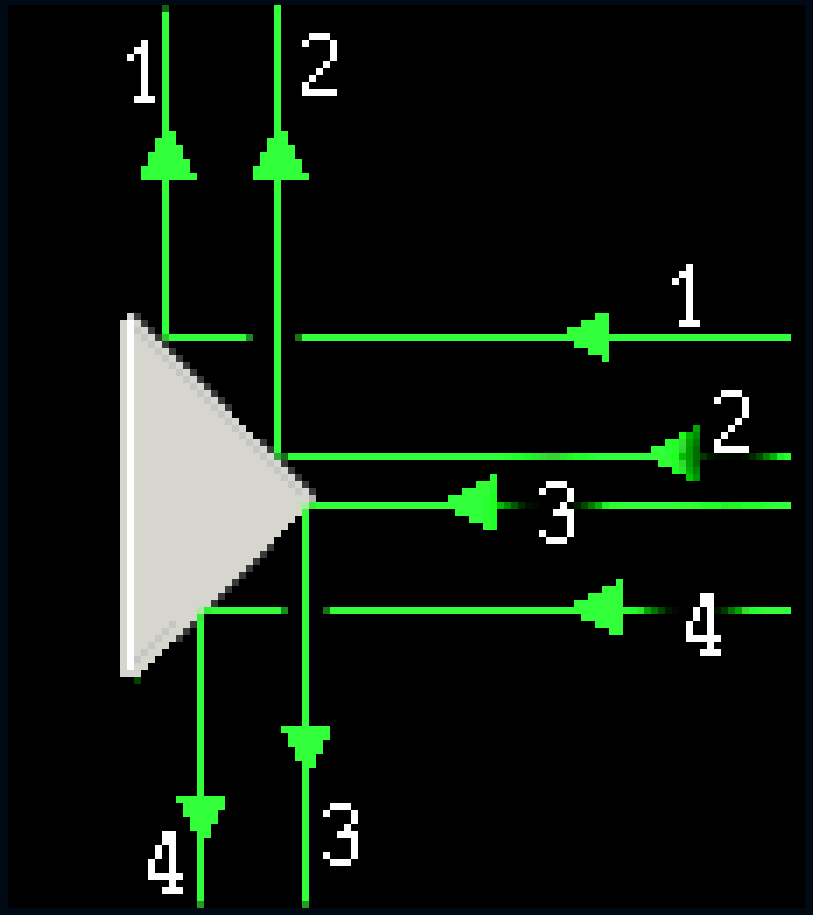
Target #1



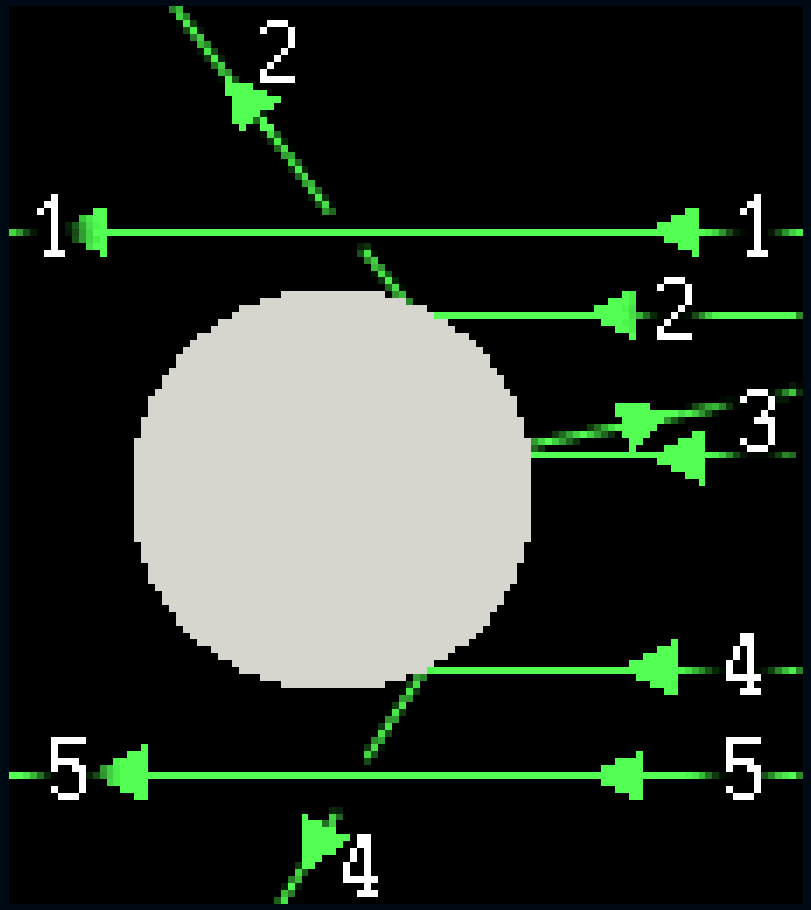


Target #2

The Answers:



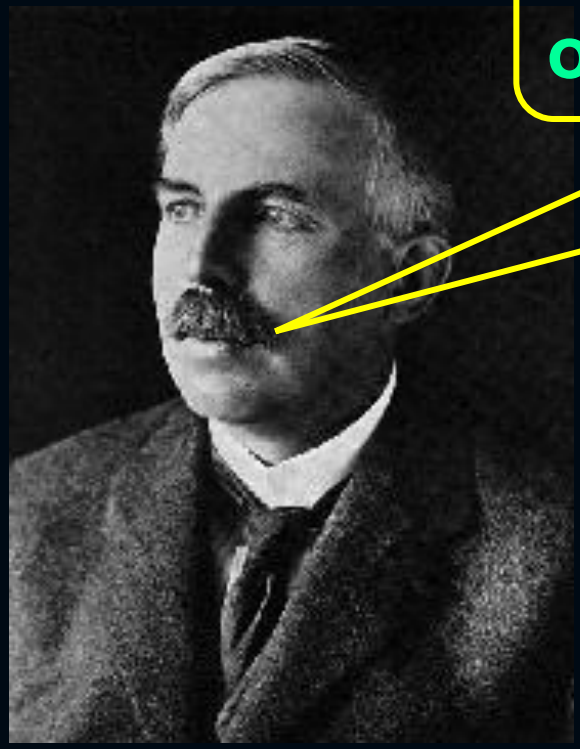
Target #1



Target #2

Rutherford's Findings

Most of the particles passed right through
A few particles were deflected
VERY FEW were greatly deflected



"Like howitzer shells bouncing off of tissue paper!"

Conclusions:

a) **The nucleus is small**
b) **The nucleus is dense**
c) **The nucleus is positively charged**

The Rutherford Atomic Model

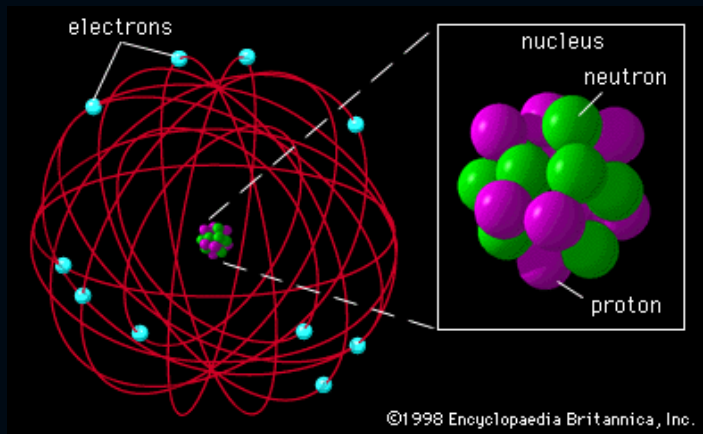
Based on his experimental evidence:

- **The atom is mostly empty space**
- **All the positive charge, and almost all the mass is concentrated in a small area in the center. He called this a "nucleus"**

The Rutherford Atomic Model

Based on his experimental evidence:

- **The nucleus is composed of protons and neutrons (they *make* the nucleus!)**
- **The e^- distributed around the nucleus, and occupy most of the volume**
- **His model was called a "nuclear model"**



Size of the Atom

If the diameter of an atom is 100 000x larger than the diameter of its nucleus, what is the diameter of an atom that has a nucleus **0.8cm** in diameter?

How to really see this

We are going to the field to look at the size of he electron cloud compared to the nucleus!

Finish Sizing Up the Atom